Van Nuys

TITLE		
HIGH GAIN SUBCARRIER OSCILLATOR	LOCKHEED LOCKHEED AIRCRAFT CORPORATION MISSILE SYSTEMS DIVISION	TEST PROCEDURE ACCEPTANCE M-033988 B SHEET 1 OF 21 SHEETS

PREPARED	TEST-DEPT	DESIGN-DEPT	RELEASE	
V. Blue	V. Blue W Mfg. Test Engrg. Dept. 68-31	51-46 51-46 2-6-58	2-3-58	(2)

REVISIONS

SYM	DATE	DESCRIPTION	FOR TEST	FOR DESIGN
"A"	8-20-58 TS.7.	Change in para. 5.27.2. From: 1% to: 2%. Added a sentence to para. 3. Revised para. 3.7. Added Oscilloscope to TEST DIAGRAM. Revised para. 5.26 thru 5.26.1. Deleted para. 5.26.2, 5.26.3 and 5.26.4.	HB.W V. Blue	
B	8-27-59 TS.7.	Complete Revision	[illegible]	[illegible] 8/27/59

Primary Use: XN Telemetry

Reference: ATS 1033988
DWG 1034099
DWG 1034095
Report #3457 - Strain Gauge Measurements for 12-204
By: L. E. Hamilton 51/46
IDC 12-204 Strain Gauge Measurements
By: L. E. Hamilton 51/46

1. INSPECTION CHARACTERISTICS

1.1 Center Frequency

1.2 Frequency Deviation

1.3 Output Voltage

1.4 Test Point Voltage

1.5 Calibrate and Strain Check

1.6 Strain Gauge Amplifier matching

1.6.1 Bias

1.6.2 Impedance

1.6.3 Gain

2. TEST EQUIPMENT

The following or equivalent equipment shall be used for this test.

2.1 Oscillator Set-Up Station

2.2 31-066A Test Set-Up Chassis

2.3 Isolation Amplifier - Keithly 102A

2.4 Bandpass filter for the specified channel

2.5 VTVM Hewlett-Packard 410B

2.6 Volt-Ohm meter Simpson 260

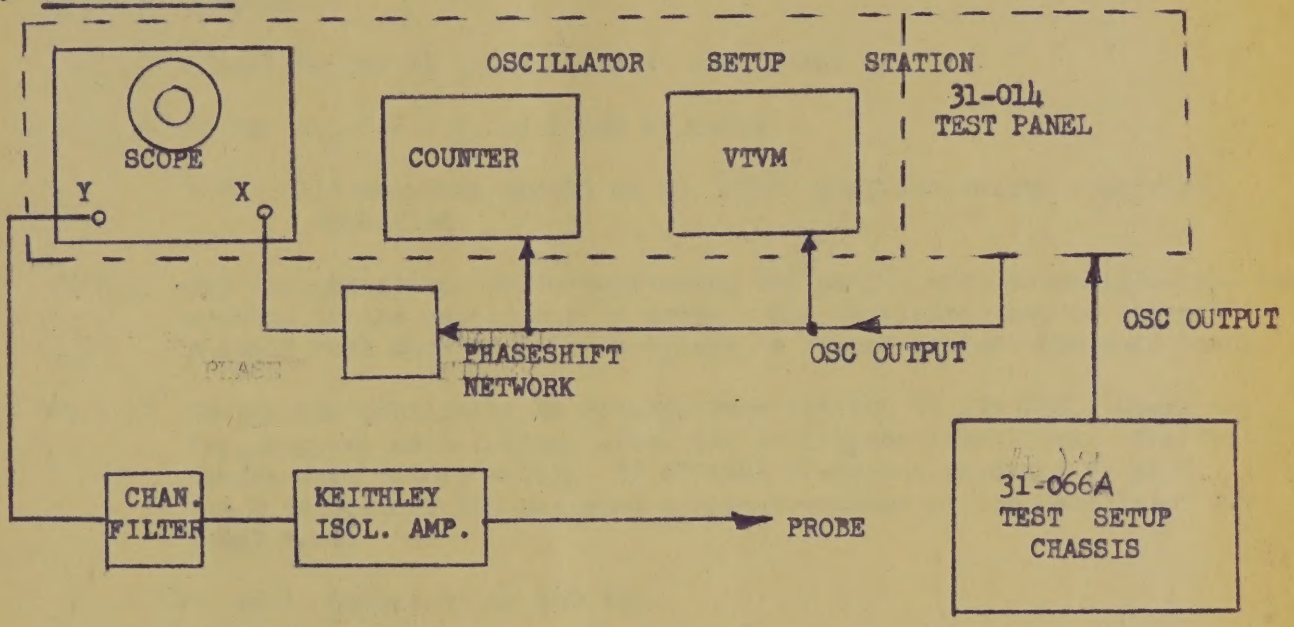
2.7 Phase Shift Network (see Test Diagram)

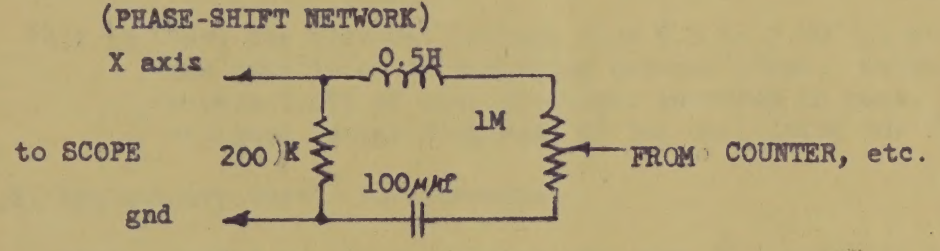
2.8 Distortion Analyzer Hewlett-Packard BR (Special)

2.9 Temperature Chamber Bemco or Statham

2.10 Oscillator Ageing Test Panel

3. TEST DIAGRAM





4. TEST PROCEDURE

4.1 Preliminary Set-up - Read para. 6. NOTES prior to this setup.

4.1.1 Energize all equipment in the Oscillator Set-Up Station and allow 10 minutes warmup period.

4.1.2 Adjust B+ to 150 VDC, filament to 6.3 VDC.

4.1.3 Set 6.8 VDC switch on the Test Set-Up Chassis to ON.

4.1.4 Select C_2, C_4 and C_{15} from the Table of Approximate Value for the assigned channel. Install them temporarily.

4.1.5 Install a 500 to 600 ohms resistor temporarily for R_{15}.

4.1.6 If the oscillator does not require a strain gauge amplifier, replace R_1 with a 10K fixed resistor and disregard para. 4.5

4.1.7 Connect the oscillator per test diagram.

4.1.8 The unit should oscillate with the components installed. Record this frequency on a pad. If it does not oscillate check for defective component.

4.1.9 Adjust R_9 for 11 $\pm$ 0.5 V RMS at test point A.

4.1.10 Adjust R_{17} for 4 $\pm$ 0.5 V RMS at output.

NOTE: All switches should be in "NORM" position unless otherwise specified.

4.1.11 Tap the oscillator while monitoring the output with an oscilloscope and examine if the oscillator is noisy. The oscillator may be "tapped" with a small tool such as a screw-driver or tapped against the work bench.

*4.1.12 Change the oscillator B+ voltage from 125 VDC to 175 VDC. Check the frequency at each voltage after the oscillator stabilizes. The frequency must remain within .3% of that frequency recorded in para. 4.1.8 or 0.3% of the assigned center frequency of the oscillator for Final Test.

4.1.12.1 Return B+ to 150 VDC.

*4.1.13 Vary the filament voltage from 5.5 to 7 VDC in steps of 0.5V and allow the oscillator to stabilize between steps. Output frequency must remain within 0.15% of that frequency recorded in para. 4.1.8 or 0.15% of the assigned center frequency of the oscillator for Final Test.

4.2 Preliminary Test - Environmental

After setting up the oscillator per para. 4.1 place it in the aging rack with input connected and operate for 48 hours. Operate for 12 hours if pre-aged tubes were installed in the oscillator.

4.2.1 Check the oscillator frequency at the beginning of 24 hour aging cycle and record on a scratch pad. The frequency shall not have drifted more than 0.5% of that frequency recorded, at the end of 24 hours.

4.2.2 Place the oscillator in the test chamber and record the frequency after 10 minutes warm-up at room temperature. This frequency shall not have drifted more than 0.5% of that frequency recorded on scratch pad in para. 4.2.1.

4.2.2.1 Operate the oscillator for thirty (30) minutes in the temperature chamber at 0°C. Record frequency at end of that time.

4.2.2.2 Operate the oscillator for thirty (30) minutes in the test chamber at 75°C. Record frequency at end of that time.

4.2.2.3 Subtract the frequency recorded under para. 4.2.2.1 from para. 4.2.2.2. If the change in frequency is greater than 3% of BW of the specified RDB channel, change R5 and R6 as follows:

If the frequency drifts with increasing temperature in the downward direction, increase the value of R_5 and decrease R6 an equal amount. If the frequency drift is in the upward direction, increase R_5 an equal amount. See attached sheet for values.

*4.3 Phasing and Balancing

4.3.1 Set S_1 to 3, S_8 to "J and B short" VTVM (AC) between TP-1 and signal ground. With the cover on the oscillator VTVM shall read no more than 10 MV RMS.

4.3.2 Phaseing - Set S_1 to 1, S_8 still in "J and B short", 10K - 10 Ω (in series) resistor between TP_1 and ground. 10 Ω resistor shall be on the ground side. Connect Keithley probe at the junction of 10 Ω and 10 KΩ resistors.

4.3.3 Adjust phasing network on the X axis input of scope for a straight line (0° phase shift).

4.3.4 With S_8 still in the "J and B short", set all switches to "Normal".

4.3.5 Bridge Balance - Connect Keithley probe to jack A.

4.3.6 Connect a pot between any pair of bridge jacks A_1 B_4 H_3 D_2 and adjust it to obtain a circle on the scope.

4.3.7 Reconnect Keithley probe to jack B.

4.3.8 Connect another pot between any pair of bridge jacks A_1 B_4 H_3 D_3 and adjust it to obtain a circle on the scope again.

4.3.9 With both pots still in the circuit, recheck the scope indication by connecting the Keithley probe on jack A and then B. Readjust pot if necessary.

4.3.10 Set S_7 to Cal 0 and then to Normal. The frequency with S_7 in Normal shall be within the limits of Cal 0 (mid-band) frequency.

*4.4 1000 μin. Strain Calibration (Oscillator only)

4.4.1 With S7 in Cal 0, change the values of C_2 and/or C_4, if necessary, until the oscillator frequency is within 2.5% of the specified RDB channel bandwidth. Increase in the value of C_4 or C_2 decreases the frequency.

4.4.2 The ratio of C_4 : C_2 shall be maintained between 5:1 and 8:1.

4.4.3 With S_7 in normal, change the value of C_{15}, if necessary so that the voltage variation on the oscillator test point A is no more than 0.2 V RMS, when S_4 is switched from + 1000 μin. to - 1000 μin., or vise versa.

4.4.4 Switch S_4 to + 1000 μ in. position.

4.4.4.1 If the frequency is below the + 42.5% BW data limit, decrease R_{15} to bring it within the required limits.

4.4.4.2 If the frequency is above the + 42.5% BW data limit, increase R_{15} to bring it within the required limits. See attached chart for values.

4.4.5 Switch the switch S_4 to - 1000 μ in. position.

4.4.5.1 If the frequency is above the - 42.5% BW data limit, decrease R_{15} to bring it within the required limits. See attached chart for values.

4.4.5.2 If the frequency is below the - 425% BW data limits, increase R_{15} to bring it within the required limits. See attached chart for values.

4.4.6 Recheck paragraph 4.4

*4.5 60 μ in. Calibration (with Strain Gauge Amplifier).

4.5.1 The amplifier shall have been tested to M034349 prior to this test. However, if it fails the following specification, perform para. 4.5.2.

4.5.1.1 Bias - with the oscillator on the circuit the voltage emitter of Q_2 in the amplifier shall be 2.45 + 0.2 V DC.

4.5.1.2 The oscillator frequency shall be the center frequency of the specified RDB channel, + 2.5% of the channel bandwidth when S_7 is operated from Cal 0 to Normal.

4.5.1.3 With S_7 in Normal, the oscillator output voltage shall not vary more than 0.2 V RMS when S_5 is switched from + 60 μ in. to - 60 μ in. or vise versa.

4.5.1.4 With S_7 in Normal set S_6 to 500 in. and record the frequency difference on a scratch pad, when S_5 is switched from + 60 μ in. to - 60 μ in. or vise versa.

4.5.1.5 Repeat 4.5.1.4 with S_6 set at "500 Ω Out."

4.5.1.6 The frequency difference ratio of para. 4.5.1.4 to 4.5.1.5 shall be 2.05 + 0.02.

*4.5.2 Strain Gauge Amplifier Set-Up

4.5.2.1 Replace R2 with a 500K pot. With a VTVM on the emitter of Q_2, adjust R_2 for a reading of 2.45 VDC.

4.5.2.2 Connect a 1 K pot for R_6, with the oscillator plugged in. Set S_6 to NORM position and adjust R_6 for full channel deviation with S_5 in + 60 μ in. and - 60 μ in. The value of R_6 shall be approximately 450 to 550 Ω. If not, check for malfunction in the oscillator.

4.5.2.3 Connect a 40K resistor for R_8.

4.5.2.4 Set S_7 to Normal. With S6 in 500 Ω IN position, record the frequency difference on a scratch pad, when S_5 is switched from + 60 μ in. to - 60 μ in., vise versa.

4.5.2.5 Repeat 4.5.2.4 with S_6 in 500 Ω out position. The ratio of the result of 4.5.2.4 to that of 4.5.2.5 shall be 2.05 $\pm$ 0.02, provided the strain gauge resistance is 350 ohms and gauge factor is 2. Decrease the value of R_8 to raise the ratio.

4.5.2.6 Repeat para. 4.5.2.1 thru 4.5.2.5 until no readjustment of the pots are necessary.

4.5.2.7 Replace R2, R6 and R8 with fixed carbon resistors. Para. 4.5.2.1 thru 4.5.2.5 should be repeated after each fixed resistor is installed in amplifier.

*4.6 Strain Set-Up for Vehicle Schedule with or without Strain Gauge Amplifier.

4.6.1 From the strain range given on the oscillator select strain simulation resistors for high end, mid range and low end of the range. Use Table I. Two of each required.

4.6.1.1 Minus Strain - Insert end strain resistors in the DOWN side bridge jacks from H_3 to A_1 and D_2 to B_4.

4.6.1.2 Plus Strain - Inset high end strain resistors in the UP side bridge jacks from A_1 to D_2 and B_4 to H_3.

4.6.1.3 Mid-Range Strain - Inset resistors as in para. 4.6.1.1 and 4.6.1.2, depending on the polarity of the strain. Should the mid-range equal to zero strain, no strain resistor is required.

4.6.2 Insert a 2.5 Meg (Balance) pot across any pair of bridge jacks opposite to the strain resistors. The balance pot, once inserted remains across the same jack throughout this test.

4.6.3 With mid-band strain resistors in appropriate jacks adjust the balance pot for mid-band frequency. Connect a 500 shunt pot across jacks A and B, if necessary, and adjust.

4.6.4 Replace the mid-band strain resistors with that of low end per para. 4.6.1.1. Adjust pots, if necessary, to obtain the specified RDB channel center frequency MINUS 42.5% to 50% of channel bandwidth.

4.6.5 Remove the low end resistor and insert the high end resistors per para. 4.6.1.2 The oscillator frequency shall be equal to the specified RDB channel center frequency PLUS 42.5% to 50% of the channel bandwidth. Re-adjust pots, if necessary.

4.6.6 Re-check mid-range, low end and high end frequencies.

4.6.7 Measure the pots (setting) and replace them with 1% carbon resistors.

4.6.8 Re-check mid-range, low end and high end frequencies. The bridge should be rebalanced with strain, balance and shunt resistors out of the circuit whenever necessary.

*4.7 Determine Calibrate R_c and C_c.

4.7.1 Insert the mid-band strain resistors and the two resistors determined in para. 4.6 in appropriate jacks.

4.7.2 Set S_7 to Cal 0.

4.7.3 Place a 2.5 Meg pot across jacks R_c.

4.7.4 With S_2 in Cal + adjust pot for + 35% (Calibrate) bandwidth of the specified channel.

4.7.5 Set S_2 to Cal -. The counter shall indicate - 35% (Calibrate) bandwidth. Adjust the pot if necessary.

4.7.6 Repeat para. 4.7.4 and 4.7.5 until the pot adjustment is not required.

4.7.7 The oscillator output voltage shall not vary more than 0.2 V RMS when S2is switched from Cal 0 to Cal + and from Cal 0 to Cal -.

4.7.7.1 If this voltage change is more than 0.2 V RMS insert a 1.0 capacitor in C_c jacks.

4.7.7.2 If Cal + voltage is still high decrease the value of C_c.

4.7.8 Measure the value of R_c and replace it with a fixed resistor.

4.7.9 Re-check BW and output voltage with S_2 in Cal + and Cal - position.

4.8 After completing para. 4.1 thru 4.7 the oscillator should be potted.

4.9 Final Test

4.9.1 With the oscillator cover on repeat appropriate paragraphs marked with asterisk. Complete MSD Form 74-2 and Component Processing Card. If the oscillator fails to meet the requirements of the ATP replace components as necessary.

5. QUALITY ASSURANCE PROVISION

5.1 Sub-Carrier Oscillator Record Sheet Form MSD 74-2 and Component Processing Card, one of each, shall be completed after the final test. Test department shall retain the Record Sheet and forward the Component Processing Card with the oscillator and the amplifier.

5.2 It is not required to perform each paragraph step by step, because of the complexity of the tests and the stringent requirements.

5.3 If rework or repair is necessary after potting, repeat the paragraphs marked with an asterisk.

5.4 Quality Assurance in the form of I spection shall be employed in a manner to assure that the provisions of this procedure are met. In case of rejection or "squawks" by Inspection, the cognizant design engineer shall have final authority to accept or reject the unit(s) under this procedure.

6. NOTES:

1. Perform all paragraphs except 4.4 for oscillator with Strain Gauge Amplifier.

2. Perform all paragraphs except 4.5 for oscillator without Strain Gauge Amplifier.

3. All paragraphs marked with an asterisk require recording on Record Sheet during Final Test para. 4.9, or when final value is determined.

TITLE

HIGH GAIN SUB-CARRIER OSCILLATOR

LOCKHEED

LOCKHEED AIRCRAFT CORPORATION
MISSILE SYSTEMS DIVISION

TEST PROCEDURE
ACCEPTANCE
M-033988

CHANNEL	C2	C4 (Approximate)	C15
1	1,300	9,100	2,400
2	1,000	6,800 + 180	1,800
3	820	5,000 + 360	1,200
4	620	3,900 + 500	1,000
5	470	3,000 + 330	680
6	360	2,400 + 270	560
7	270	1,600 + 160	390
8	200	1,300 + 160	300
9	160	1,000 + 100	200
10	120	750 + 15	139
11	82	560 + 36	100
12	56	390 + 27	68
13	43	270	39
14	22	180	10

NOTE: Capacitor Values are in micromicro farads and may be made up from parallel combinations.

TABLE I.

STRAIN (μ in.)	STRAIN RESISTANCE (Ω)
25	7M
50	3.5M
60	2.916M
65	2.692M
75	2.332M
100	1.75M
120	1.458M
125	1.4M
130	1.346M
150	1.166M
200	875K
250	700K
300	583.3K
350	500K
400	437.5K
500	350K
600	291.6K
700	250K
800	218.75K
1000	175K
1100	159K
1200	145.8K
300	50.3K

NOTE:

1. Use the following formula to calculate the strain resistor (RS) value if not given in Table.

$$R \text{ Strain} = \frac{R_o}{S \text{ (G.F.)}}$$

Where R_S = Strain Resistance (Ω)
S = Strain in μ in.
G.F. = Gauge Factor

2. Above Table is for R_o = 350Ω and G.F. = 2